U.S. Department of Energy - Energy Efficiency and Renewable Energy

Energy Savers

Ventilation Preheating

Solar air heating systems use air as the working fluid for absorbing and transferring solar energy. Solar air collectors (devices to heat air using solar energy) can directly heat individual rooms or can potentially pre-heat the air passing into a heat recovery ventilator or through the air coil of an air-source heat pump.

Air collectors produce heat earlier and later in the day than liquid systems, so they may produce more usable energy over a heating season than a liquid system of the same size. Also, unlike liquid systems, air systems do not freeze, and minor leaks in the collector or distribution ducts will not cause significant problems, although they will degrade performance. However, air is a less efficient heat transfer medium than liquid, so solar air collectors operate at lower efficiencies than solar liquid collectors.

Although some early systems passed solar-heated air through a bed of rocks as energy storage, this approach is not recommended because of the inefficiencies involved, the potential problems with condensation and mold in the rock bed, and the effects of that moisture and mold on indoor air quality.

Solar air collectors are often integrated into walls or roofs to hide their appearance. For instance, a tile roof could have air flow paths built into it to make use of the heat absorbed by the tiles. Air entering a collector at 70°F (21.1°C) is typically warmed an additional 70°–90°F (21.1°–32.2°C.). The air flow rate through standard collectors should be 1–3 cubic feet (0.03–0.76 cubic meters) per minute for each square foot (0.09 square meters) of collector. The velocity should be 5–10 feet (1.5–3.1 meters) per second.

Most solar air heating systems are room air heaters, but relatively new devices called transpired air collectors have limited applications in homes.

Room Air Heaters

Air collectors can be installed on a roof or an exterior (south facing) wall for heating one or more rooms. Although factory-built collectors for on-site installation are available, do-it-yourselfers may choose to build and install their own air collector. A simple window air heater collector can be made for a few hundred dollars.

The collector has an airtight and insulated metal frame and a black metal plate for absorbing heat with glazing in front of it. Solar radiation heats the plate that, in turn, heats the air in the collector. An electrically powered fan or blower pulls air from the room through the collector, and blows it back into the room. Roof-mounted collectors require ducts to carry air between the room and the collector. Wall-mounted collectors are placed directly on a south-facing wall, and holes are cut through the wall for the collector air inlet and outlets.

Simple "window box collectors" fit in an existing window opening. They can be active (using a fan) or passive. In passive types, air enters the bottom of the collector, rises as it is heated, and enters the room. A baffle or damper keeps the room air from flowing back into the panel (reverse thermosiphoning) when the sun is not shining. These systems only provide a small amount of heat, since the collector area is relatively small.

Transpired Air Collectors

Transpired air collectors use a simple technology to capture the sun's heat to warm buildings: The collectors consist of dark, perforated metal plates installed over a building's south-facing wall. An air space is created between the old wall and the new facade. The dark outer facade absorbs solar energy and rapidly heats up on sunny days—even when the outside air is cold.

A fan or blower draws ventilation air into the building through tiny holes in the collectors and up through the air space between the collectors and the south wall. The solar energy absorbed by the collectors warms the air flowing through them by as much as 40°F. Unlike other space heating technologies, transpired air collectors require no expensive glazing.

Transpired air collectors are most suitable for large buildings with high ventilation loads, a fact which makes them generally unsuitable for today's tightly sealed homes. However, small transpired air collectors could be used to pre-heat the air passing into a heat recovery ventilator or could warm the air coil on an air source heat pump, improving its efficiency and comfort level on cold days. However, no information is currently available on the cost effectiveness of using a transpired air collector in this way.

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Reading List

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